I-19 CORRIDOR PROFILE STUDY

NOGALES TO JUNCTION I-10

ADOT Work Task No. MPD 072B-14

ADOT Contract No. 11-013164

Draft Working Paper 5: Strategic Solutions

September 2015

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ACRONYMS

ADOT	Arizona Department of Transportation
AZTDM	Arizona Travel Demand Model
DCR	Design Concept Report
FY	Fiscal Year
HCRS	Highway Condition Reporting System
HERE	Real time traffic conditions database produced by American Digital Cartography Inc.
HPMS	Highway Performance Monitoring System
I-19	Interstate 19
LOS	Level of Service
MP	Milepost
NB	Northbound
OP	Overpass
PAG	Pima Association of Governments
P2P	Planning to Programming
PDI	Pavement Distress Index
PSR	Pavement Serviceability Rating
PTI	Planning Time Index
SB	Southbound
SHSP	Strategic Highway Safety Plan
SPUI	Single Point Urban Interchange
SR	State Route
TI	Traffic Interchange
TIP	Transportation Improvement Plan
TPTI	Truck Planning Time Index
TTI	Travel Time Index
TTTI	Truck Travel Time Index
UP	Underpass
V/C	Volume to Capacity Ratio

1 INTRODUCTION

Interstate 19 (I-19) is a major corridor for intrastate and international commerce between Mexico and the United States. It is one of nine Arizona Department of Transportation (ADOT) defined corridors that play a key role in the understanding the overall health of the statewide transportation system. The statewide plan, *What Moves You Arizona*, and the *Planning to Programming Linkage (P2P)* have begun developing a framework to integrate the planning and programming process in a transparent, defensible, logical, and reproducible way. The I-19 Corridor Profile Study is one piece that will begin to connect strategic decisions to on-the-ground improvements.

Corridor Study Purpose

This series of corridor profile studies will examine significant state corridors and compare performance to goals using performance measures identified in the P2P process. The purpose of these studies will be to identify the gap between measured performance and stated goals and to perform a comparative analysis both within the I-19 corridor and with other statewide significant corridors. This effort will result in the prioritization of solutions that will improve the overall performance of the I-19 corridor. The process by which this corridor profile study will achieve the desired results will focus on the following process areas:

- Inventory past recommendations for improvements that have been completed or are in progress;
- Provide an overall assessment of the existing health of the corridor, based on system performance measures;
- Recommend a range of solution sets to help improve the overall performance;
- Determine how proposed corridor improvements will be prioritized based on a risk-based decision process; and
- Complete a P2P ranking of proposed improvements and recommend strategic initiatives.

Corridor Study Objectives

The I-19 Corridor Profile Study will define solution sets and improvements that can be evaluated and ranked to determine which investments offer the greatest benefit to the corridor. Corridor benefits will be documented by three investment types including preservation, modernization, and expansion. The main objective of this study will be to identify potential actions that will increase the performance of the I-19 corridor to acceptable levels. These actions or projects will be analyzed based on risk potential, life-cycle costs, and cost-benefits to produce a prioritized list of projects that help achieve corridor goals. The following goals have been identified as the outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals;
- Match solutions with deficiencies in measured performance; and
- Prioritize improvements that efficiently preserve, modernize, and expand transportation infrastructure.

Study Location and Corridor Segments

The I-19 Corridor is a multi-modal corridor located in southern Arizona that serves international, regional, and local traffic and commerce demand between the United States and Mexico. I-19 spans approximately 64 miles from the international border near Nogales, Arizona north to the junction with Interstate 10 (I-10) at milepost 63.69 in Tucson, Arizona as illustrated in **Figure 1.**

The I-19 Corridor is divided into six planning segments for analysis and evaluation. These planning segments allow the corridor to be analyzed at a detailed level so that location-specific needs can be readily identified and compared to other segments on this or other corridors. Segmentation by similar characteristics will allow the analysis to highlight anomalies or instances of poor performance within the context of each segment. Planning segments for the I-19 Corridor are defined in **Table 1.**

The planning segments were created to define a consistent method of grouping data and to define a level of granularity appropriate for supporting long range corridor-level priority decisions. In order to measure and compare planning segments to each other and to the system as a whole, the root data set is normalized to represent each planning segment. The data is utilized either as point source information, e.g., specific location of an accident, or by length, e.g., a series of maintenance sections with a specific pavement condition.

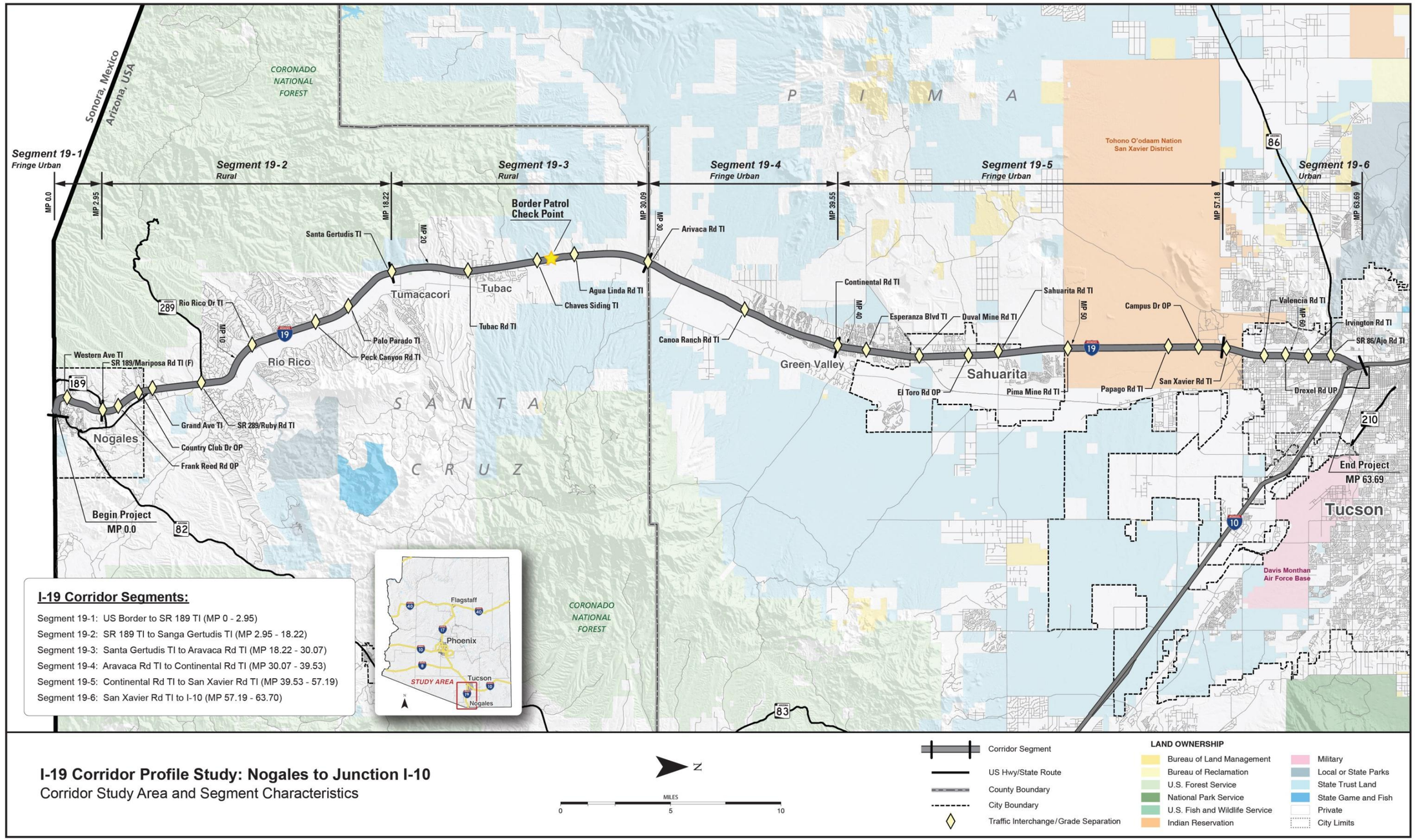
Table 1: I-19 Corridor Segments

Seg #	Segment Name	Begin Milepost	End Milepost	Surface Width (NB)	Thru Lanes (NB)	Length (mi)
1	US Border to SR 189 TI	0.00	2.95	24’-36’	2	2.95
2	SR 189 TI to Santa Gertudis TI (Rock Corral Rd)	2.95	18.24	24’-36’	2	15.29
3	Santa Gertudis TI to Arivaca Rd TI	18.24	30.09	24’	2	11.85
4	Arivaca Rd TI to Continental Rd TI	30.09	39.55	24’	2	9.46
5	Continental Rd TI to San Xavier Rd TI	39.55	57.18	24’-36’	2	17.63
6	San Xavier Rd TI to I-10	57.18	63.69	24’-48’	2-3	6.51

Working Paper #5 Objectives

The objective of Working Paper #5 is to document the development of strategic solutions derived from a performance-based needs assessment for the I-19 corridor. Corridor needs (Working Paper #4) were defined through a review of the difference in baseline corridor performance.

Figure 1: Corridor Location and Segments



2 SUMMARY OF CORRIDOR NEEDS

Summary of Needs

Working Paper #4 documented the framework for the performance-based needs assessment process and the results for the I-19 corridor. The needs in each performance area were classified as either None, Low, Medium, or High based on how well each segment performed in the existing performance analysis conducted in Working Paper #2. The needs for each segment were combined to numerically estimate the average level of need for each segment of the corridor.

During the Corridor Vision process for I-19 (Working Paper #3), the Mobility, Safety and Freight Performance Areas were identified as Emphasis Areas, reflecting the future vision of the corridor as a significant facility for the movement of international goods. Therefore, a weighting factor of 1.50 was applied to those needs during the calculation process in order to ensure appropriate attention to the developing commercial route.

The needs for the I-19 corridor are summarized below.

Pavement Performance Area

- Pavement hotspots were identified on approximately four miles of the 63 mile corridor in four locations on three segments.
- Two of the pavement hotspots have a particularly high level of historical investment, meaning that some projects have proven to provide only temporary improvements and require frequent attention.

Bridge Performance Area

- Bridge Needs occur due to poor performing bridges or hotspots on four of six segments.
- Bridge Needs were identified at 13 of the total 74 bridges (18%).
- Six bridges have potential repetitive investment issues which may be candidates for life-cycle cost analysis to evaluate alternative solutions.

Mobility Performance Area

- The Mobility Performance Area is an Emphasis Area for the I-19 corridor, giving it a heavier weight in the analysis.
- Mobility Needs were identified only on segment 19-6 in the Tucson area related to high traffic volumes and poor level of service values.
- Traffic volumes are equally high seven days per week.

Safety Performance Area

- The Safety Performance Area is an Emphasis Area for the I-19 corridor, giving it a heavier weight in the analysis.
- Safety Needs were identified in segment 19-5, including two crash hotspots north of Sahuarita.

Freight Performance Area

- The Freight Performance Area is an Emphasis Area for the I-19 corridor, giving it a heavier weight in the analysis.
- Freight needs are identified on segment 19-1 in the Nogales area, related to heavier volumes of commercial truck traffic in the transition zone from non-divided highway to freeway, as well as terrain which affect reliability factors that look at actual speeds related to posted speed limits.
- Truck traffic is also affected by slowdowns in segment 19-3 related to the Border Patrol checkpoint north of Tubac.

Following the distribution of Draft Working Paper #4 - Needs Assessment, several modifications were made to the performance system and the needs assessment process. Adjustments to the methodology used to calculate needs were adjusted to more accurately reflect conditions across the corridors and may differ from those shown in earlier draft documents. Those adjustments are reflected in **Figure 2: Summary of Needs** which shows all needs identified in the assessment, ranging from None to High.

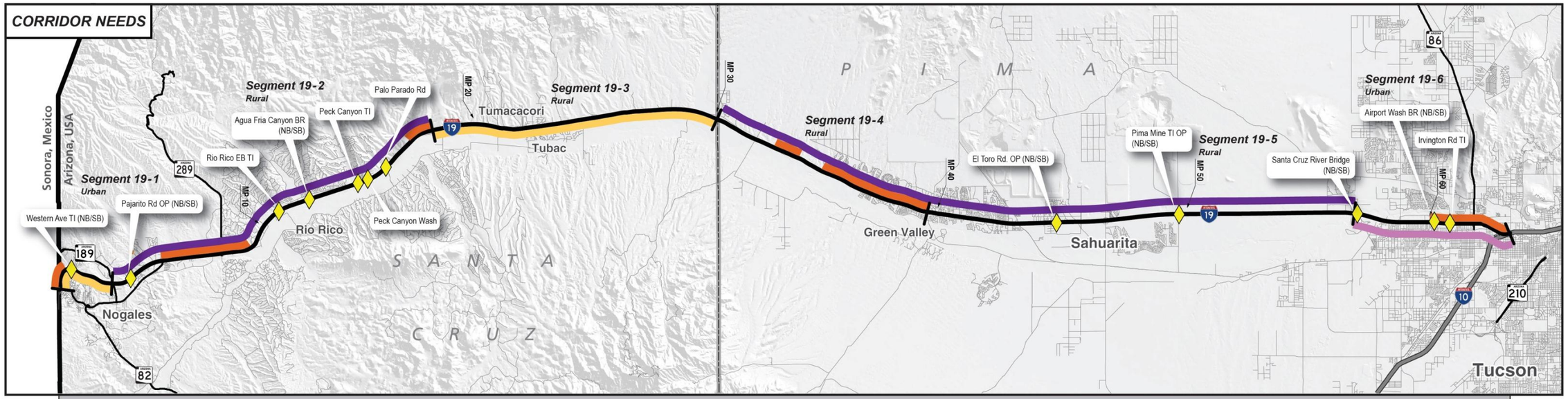
Strategic Investment Areas

In an effort to focus on the most significant issues identified throughout the corridor, only needs that will result in strategic investment will be considered for solutions. Needs that do not require strategic investment, as identified through this process, will be removed from further analysis.

High and Medium segment level needs, as well as any segment regardless of level of need with an identified hotspot are considered candidates for strategic investment, for which solutions will be developed. Segments with None or Low levels of need without any apparent hotspots are not considered candidates for strategic investment and will likely be addressed through other ADOT programming processes. Following this criteria, the levels of need identified on segments 19-3 and 19-4 do not qualify for strategic investment consideration.

Figure 3: Strategic Investment Areas illustrates locations on the I-19 corridor for which solutions will be identified.

Figure 2: Summary of Corridor Needs



	SEGMENT						
Segments	**19-1**	**19-2**	**19-3**	**19-4**	**19-5**	**19-6**	**Segments**
Pavement	Low	Low	None	Low	None	Low	**Pavement**
Bridge	Med	Low	None	None	High	Low	**Bridge**
Mobility*	Low	None	Low	None	Low	High	**Mobility***
Safety*	None	Low	None	Low	Medium	None	**Safety***
Freight*	High	None	Low	None	None	None	**Freight***
Avg Need (0-3)	**1.4**	**0.5**	**0.5**	**0.4**	**1.2**	**1.0**	**Avg Need (0-3)**

I-19 Corridor Profile Study: Nogales to Junction I-10
Summary of Corridor Needs

N

MILES
0 5 10

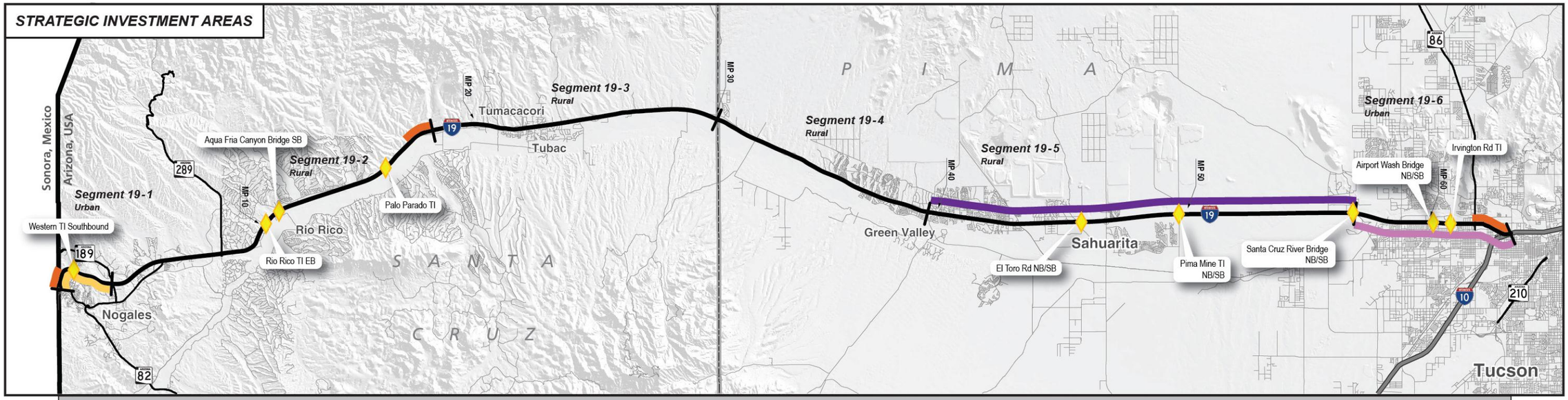
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary

NEEDS SYMBOLOGY
SAFETY NEEDS
PAVEMENT NEEDS
FREIGHT NEEDS
MOBILITY NEEDS
BRIDGE NEEDS

LEVEL OF NEED
Low
Medium
High

*Indicates an Emphasis Area where a weight of 1.5 is applied to the deficiency level for each performance area.

Figure 3: Strategic Investment Areas



Segments	SEGMENT 19-1	19-2	19-3	19-4	19-5	19-6	Segments
Pavement	Hotspot	Hotspot	–	–	–	Hotspot	Pavement
Bridge	Med	Hotspot	–	–	High	Hotspot	Bridge
Mobility	–	–	–	–	–	High	Mobility
Safety	–	–	–	–	Medium	–	Safety
Freight	High	–	–	–	–	–	Freight

I-19 Corridor Profile Study: Nogales to Junction I-10
Strategic Investment Areas

N

MILES
0 5 10

Corridor Segment
US Hwy/State Route
County Boundary
City Boundary

MAP SYMBOLOGY
SAFETY NEEDS
PAVEMENT NEEDS
FREIGHT NEEDS
MOBILITY NEEDS

LEVEL OF NEED
Low
Medium
High

3 STRATEGIC INVESTMENT AREA SCREENING

This section examines the needs identified in Section 2 that qualify for strategic investment and determines if the needs in those locations require action. **Table 2** notes if each potential strategic need location will advance to solution set development, and if not the reason for screening out. Locations advancing to solutions development are marked with Yes (Y); locations not advancing are marked with No (N) and grayed out.

In some cases, needs that have been identified will not advance to solutions set development and will be screened out from further consideration because it has been or will be addressed through other measures including:

- A project has already been programmed to address this need
- The need is a result of a pavement or bridge hotspot that does not show historical investment issues as identified in Working Paper #4. These hotspots will likely be addressed through other ADOT programming means.
- The need is determined to be 'non-actionable' as is the case in Segment 19-3, where the Freight need is due to the presence of a US Customs and Border Patrol Checkpoint. There is no solution to mitigate this need because all traffic must stop for inspection. Therefore, no improvement can be recommended at this time.
- The conditions/characteristics of the location have changed since the performance data was collected that was used to identify the need.

The remainder of the study will focus on developing appropriate solutions for the advancing locations. The table provides specific information about the needs in each segment that will be considered for strategic investment. The table identifies the level of need – either Medium or High and the presence of hotspots, if they are identified in a segment without a Medium or High level of need, which also triggers consideration for a strategic investment. Each area of need has been assigned a Location Number to help document and track specific locations that are being considered for strategic investment throughout this process.

Table 2: Strategic Investment Area Screening

Segment	Level of Strategic Need					Location #	Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
19-1	Hotspot	Medium	-	-	High	L1	Pavement	Hotspot in northbound lanes MP 0-1	N	Pavement preservation project programmed MP 0-3 FY 2015 will address deficiency
						L2	Bridge	Medium level of need, including a hotspot at the Western TI Overpass (SB) (#1546) with deck rating 5, superstructure rating 5	N	Structure does not meet criteria for historical review, therefore not considered for strategic investment
						L3	Freight	High level of need resulting from Poor Travel Time Index and Planning Time Index	N	Future reconstruction SR 189/Mariposa TI will redirect truck traffic and will address deficiency
19-2	Hotspot	Hotspot	-	-	-	L4	Pavement	Hotspot on northbound side from MP 17-18.5, which includes an area of high historical investment	N	Pavement preservation project programmed MP 15-21 FY 2016 will address deficiency
						L5	Bridge	Hotspot at Rio Rico TI (EB) (#933) with deck rating 5, superstructure rating 5	N	Structure does not meet criteria for historical review, therefore not considered for strategic investment
						L6	Bridge	Hotspot at Agua Fria Canyon Bridge (NB) (#353) with deck rating 5, superstructure rating 5	N	Structure does not meet criteria for historical review, therefore not considered for strategic investment
						L7	Bridge	Hotspot at Agua Fria Canyon Bridge (SB) (#906) with deck rating 5, superstructure rating 5, substructure rating 5	Y	Meets criteria for strategic investment
						L8	Bridge	Hotspot at Palo Parado TI (#937) with deck rating 5, superstructure 5	Y	Meets criteria for strategic investment
19-3	-	-	-	-		NA	NA	None	N	NA
19-4	-	-	-	-	-	NA	NA	None	N	NA
19-5	-	High	-	Medium	-	L9	Bridge	Hotspot at El Toro Road Overpass (NB) (#1572) with deck rating 4	Y	Bridge deck rehabilitation project programmed FY 2016 (design only); advance for construction consideration
						L10	Bridge	Hotspot at El Toro Road Overpass (SB) (#1573) with deck rating 4	Y	Bridge deck rehabilitation project programmed FY 2016 (design only); advance for construction consideration
						L11	Bridge	Hotspot at Pima Mine OP (NB) (#1303) with deck rating 4	N	Bridge deck rehabilitation project programmed for construction FY 2016 will address deficiency
						L12	Bridge	Hotspot at Pima Mine OP (SB) (#1304) with deck rating 4	N	Bridge deck rehab project programmed for construction FY 2016 will address deficiency
						L13	Bridge	Hotspot at Santa Cruz River Bridge (NB) (#1243) with deck rating 4	N	Bridge deck rehab project programmed for construction FY 2016 will address deficiency
						L14	Bridge	Hotspot at Santa Cruz River Bridge (SB) (#1244) with deck rating 4	N	Bridge deck rehab project programmed for construction FY 2016 will address deficiency
						L15	Safety	Medium level of need with hotspots northbound lanes at MP 53-56	Y	Meets criteria for strategic investment
						L16	Safety	Medium level of need with hotspots southbound lanes at MP 47-49	Y	Meets criteria for strategic investment
19-6	Hotspot	Hotspot	High	-	-	L17	Pavement	Hotspot NB/SB at MP 62-63.7	Y	I-19 reconstruction project programmed FY 2015 and FY 2018 MP 58-62; recommend modifying existing programmed project to address hotspots
						L18	Bridge	Hotspot at Airport Wash Bridge (NB) (#1121) with deck rating 5, superstructure rating 5	Y	Meets criteria for strategic investment
						L19	Bridge	Hotspot at Airport Wash Bridge (SB) (#1122) with deck rating 5, superstructure rating 5	Y	Meets criteria for strategic investment
						L20	Bridge	Hotspot at Irvington Road TI (#1123) with deck rating 5, superstructure rating 5	Y	TI design programmed FY 2019; advance for construction consideration
						L21	Mobility	High level of need resulting from poor current and future volume to capacity ratios	Y	Meets criteria for strategic investment. Ajo Way TI reconstruction project programmed 2018 will address some of deficiency

Indicates location that does not meet criteria for strategic investment

4 CANDIDATE SOLUTIONS

The principal objective of the corridor profile study is to identify performance-based strategic solutions (investments) to help inform decision-making processes. This will enable ADOT to direct available funding resources to maximize the performance of the State's key transportation corridors. The corridor profile process is designed to mesh with the Planning to Programming Link (P2P) and assigns strategic solutions to one of three categories for investment:

- Preservation
- Modernization
- Expansion

The performance needs previously documented in Working Paper #4 serve as the foundation for developing strategic solutions for corridor preservation, modernization, and expansion. Strategic investments are not intended to be a substitute or replacement for traditional ADOT project development processes where various candidate projects are developed for consideration in programming in the P2P Link process. Rather, strategic solutions are intended to complement ADOT's traditional project development processes through a performance-based process to address needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Strategic solutions developed for key corridors will be considered along with other candidate projects in the ADOT programming process.

Characteristics of Strategic Solutions

For the purposes of the corridor profile process, strategic solutions include the following characteristics:

- Do not recreate or replace results from normal programming processes.
- May include programs or initiatives, areas for further study, and infrastructure projects.
- Address elevated levels of need (high or medium) and hotspots.
- Focus on investments in Modernization projects (to optimize current infrastructure).
- Address overlapping needs.
- Reduce costly repetitive maintenance.
- Extend operational life of system and delay expansion.
- Leverage programmed projects that can be expanded to address other strategic elements.
- Provide measureable benefit (benefit/cost ratio, risk, LCCA, performance system, etc.).

Strategic Solutions Types

Establishing uniform solution types will enable the corridor profile process to compare proposed solutions on and across corridors to determine effectiveness at improving performance, including cost and risk comparisons to be undertaken in subsequent tasks. **Appendix A** provides a list of the preliminary solutions currently proposed for the I-17, I-19, and I-40 West corridors which are separated into the three funding categories (Preservation, Modernization, or Expansion).

Candidate Solutions

The final step in this task is to identify candidate solutions that will be submitted for further analysis through the life cycle cost and risk analysis tasks. The project team accessed a variety of resources to identify solutions to address strategic investment areas:

- Field reviews
- Observable trends from performance analysis
- Discussions with districts
- ADOT technical groups
- Review previous reports
- National best practices
- Professional judgment

Table 3 identifies each deficient location that has been assigned a solution, with a number (i.e. CS 19.1, 19.2, etc.,) based on the solution types in the previous section. The assigned CS number will provide tracking capability through the rest of the process.

In some cases, multiple solutions are proposed for a single location. The solutions that are proposed to address the same need location will be advanced to the Life Cycle Cost and Benefit Cost Analysis evaluation in Task 6 with the intent of selecting one recommended solution per location to advance to the Risk Analysis evaluation in Task 7. In locations where only one option has been developed, the next step will be to advance that solution directly to the Risk Analysis evaluation where they will be prioritized.

Solutions that are recommended to expand or modify the scope of an already programmed project are noted and will not be advanced to the Life Cycle Cost, Benefit Cost, or Risk Analysis evaluation. These solutions will be directly recommended for programming because they are not considered standalone. These recommendations should be considered as part of scope expansion in order to fully address identified needs within the I-19 corridor. They will be carried forward into the final recommendations as part of Task 8.

Candidate Solutions

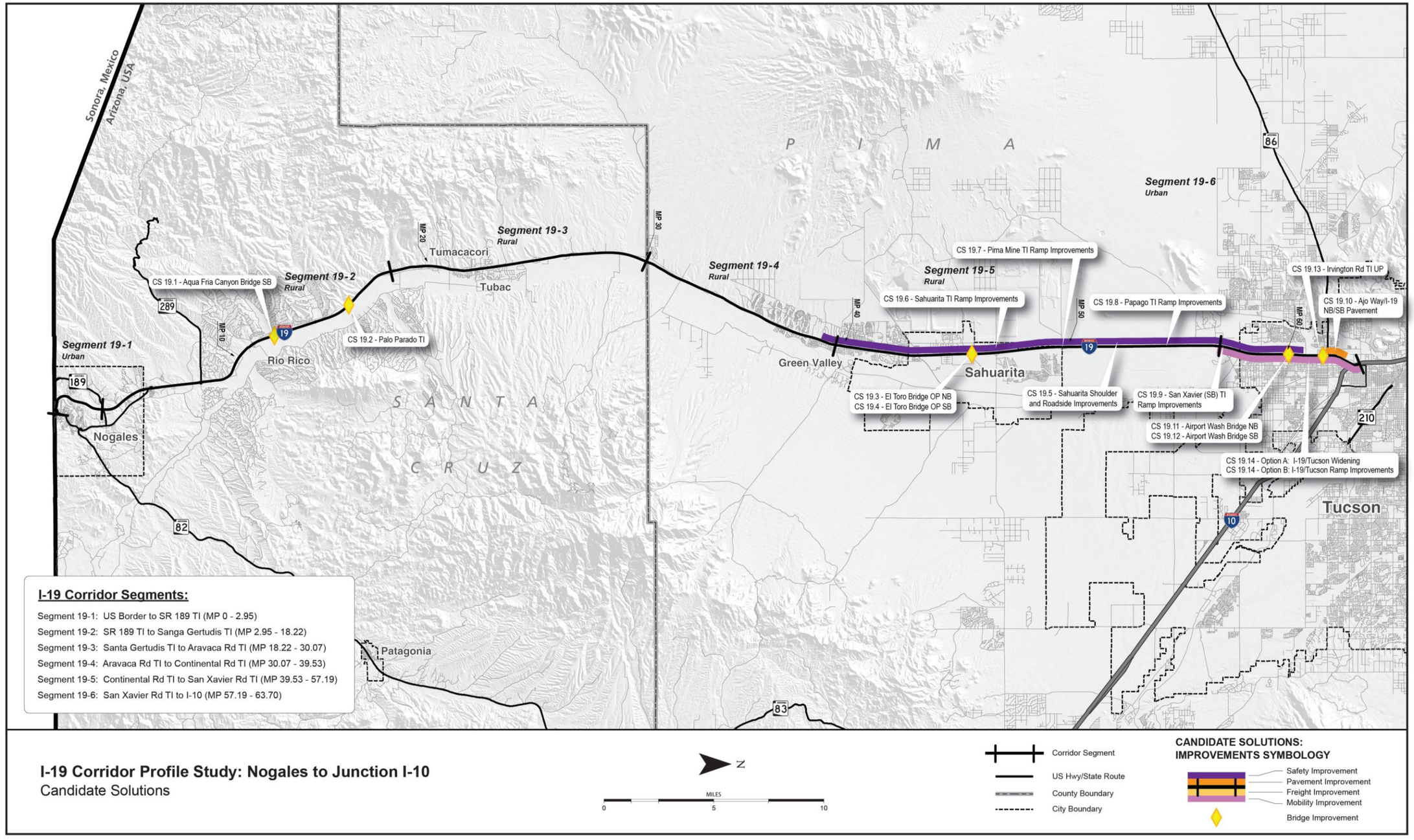
Following the screening process, strategic solutions were developed for each remaining location. **Table 3** contains the candidate strategic solution for each location. In some cases, multiple candidate solutions are proposed for a single location. These options will be evaluated in subsequent tasks (Task 6) with the intent of identifying one recommended solution for each location. Task 6 will utilize life-cycle cost analyses and Benefit Cost Analyses to evaluate the options.

The strategic investment areas and their related solutions are shown in **Figure 4.**

Table 3: Candidate Construction Program Solutions

Solution #	Location #	BMP	EMP	Name	Option	Scope	P/M/E
CS19.1	L7	12.0	12.0	Agua Fria Canyon Bridge SB (#906)	A	Rehabilitate bridge	P
					B	Replace bridge	M
CS19.2	L8	15.7	15.7	Palo Parado Rd Bridge (#937)	A	Rehabilitate bridge	P
				Palo Parado Rd Bridge (#937)	B	Replace bridge	M
CS19.3	L9	45.8	45.8	El Toro Bridge OP NB (#1572)	-	Rehabilitate bridge following programmed design FY 2016	P
CS19.4	L10	45.8	45.8	El Toro Bridge OP SB (#1573)	-	Rehabilitate bridge following programmed design FY 2016	P
CS19.5	L15/16	39.5	61.9	Sahuarita to Tucson Shoulder and Roadside Improvements	-	Rehabilitate shoulders and enhance roadway delineation (pavement marking, delineators, rumble strips) Sahuarita Rd to Irvington Rd.	M
CS19.6	L15/16	39.5	39.5	Sahuarita TI Ramp Improvements	-	Construct/extend parallel entrance and exit ramps at Sahuarita TI	M
CS19.7	L15/16	49.6	49.6	Pima Mine TI Ramp Improvements	-	Construct/extend parallel entrance and exit ramps at Pima Mine TI	M
CS19.8	L15/16	54.4	54.4	Papago TI Ramp Improvements	-	Construct/extend parallel entrance and exit ramps at Papago TI	M
CS19.9	L15/16	57.0	57.0	San Xavier (SB) TI Ramp Improvements	-	Construct/extend parallel entrance and exit ramps at San Xavier (SB) TI	M
CS19.10	L17	62.0	63.0	Ajo Way/I-19 NB/SB Pavement	-	Rehabilitate pavement as modification to existing programmed project, including extending project limit to MP 62-63 NB	P
CS19.11	L18	60.3	60.3	Airport Wash Bridge NB (#1121)	A	Rehabilitate bridge	P
					B	Replace bridge	M
CS19.12	L19	60.3	60.3	Airport Wash Bridge SB (#1122)	A	Rehabilitate bridge	P
					B	Replace bridge	M
CS19.13	L20	61.9	61.9	Irvington Rd TI UP (#1123)	-	Rehabilitate bridge following programmed design FY 2019	P
CS19.14	L21	57.0	64.0	I-19/Tucson Ramp Improvements	A	Improve entry/exit ramps and implement ramp metering at Irvington Rd SB, Valencia Rd NB/SB, and San Xavier Rd NB	M
				I-19/Tucson Widening	B	Construct new general purpose lane (inside) in NB/SB direction between Irvington Rd and San Xavier Rd	E

Figure 4: Candidate Solutions



Other Corridor Recommendations

In addition to the recommended construction program solutions identified in **Table 3**, this corridor profile study recommends that ADOT consider additional strategies for I-19 that are compatible with the long range vision to support international and interregional truck and freight movements:

- The analysis shows a high ratio of fatal to incapacitating injury crashes that are not clearly patterned to specific locations. This report recommends that a Roadway Safety Analysis should be conducted on the corridor in order to better understand the high occurrence of fatal crashes.
- Consider a corridor strategy to upgrade all bridges to current standards in anticipation of increased truck/freight traffic over the medium to long term.
- Consider corridor wide ITS solutions to assist truck/freight traffic over the medium to long term.

Policies and Initiatives

In addition to location specific needs, general corridor and system wide needs were also identified through the corridor profile process. While these needs are more overarching and cannot be individually evaluated through this process, it is important to document them as well. Therefore, a recommended policies and initiatives list was developed for consideration when programming future projects not only on I-19, but across the entire state highway system where the conditions are applicable. The following list was derived from the I-19, I-17, and I-40 West Corridor Profile Studies and will be expanded to include recommendations from subsequent corridors as they are developed. **Appendix A** defines these policies and recommendations in more detail and describes how and where they are applicable across the state.

- Install ITS conduit with all new infrastructure projects.
- Prepare strategic plans for Closed Circuit Television (CCTV) and Road Weather Information System (RWIS) locations statewide.
- Leverage power and communication at existing weigh-in-motion (WIM), dynamic messaging signs (DMS), and call box locations to expand ITS applications across the state.
- Consider solar power for lighting and ITS where applicable.
- Investigate ice formation prediction technology where applicable.
- Conduct highway safety manual evaluation for all future programmed projects.
- Develop infrastructure maintenance and preservation plans (including schedule and funding) for all pavement and bridge infrastructure replacement or expansion projects.
- Develop standardized bridge maintenance procedures so districts can do routine maintenance work.
- Review historical ratings and investment level during scoping of all new pavement and bridge projects. In areas that warrant further investigation, conduct subsurface investigations during project scoping to determine if full replacement is warranted.
- For pavement rehabilitation projects, enhance the amount/level of geotechnical investigations to address issues specific to the varying conditions along the project.
- Expand programmed and future pavement projects as necessary to include shoulders.
- Expand median cable barrier guidelines to account for safety performance.
- Install CCTV with all DMS.
- In locations with limited communications, use CCTV to provide still images rather than streaming video.
- Develop statewide program for pavement replacement
- Install additional continuous permanent count stations along strategic corridors to enhance traffic count data.

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5 NEXT STEPS

Candidate Solutions identified in Working Paper 5 will advance to be evaluated in multiple ways including a Life Cycle Cost or Benefit Cost Analysis (where applicable), Risk Analysis, and a Performance Effectiveness Analysis. The methodology and approach to this analysis is briefly described below and will be documented in detail in Working Paper #6. **Figure 5** illustrates the candidate solution evaluation process.

Life Cycle Cost Analysis – All pavement and bridge candidate solutions have two options, rehabilitate the area of need, or fully reconstruct the issue area or structure. These options will be evaluated through a life cycle cost analysis to determine the best approach for each location where a pavement or bridge solution is recommended. The recommended option will be advanced to the Performance Effectiveness and Risk Analysis evaluations.

Benefit Cost Analysis – Any strategic issue area that resulted in multiple independent candidate solutions will be evaluated through a benefit cost analysis to determine the best solution. The recommended option will be advanced to the Performance Effectiveness and Risk Analysis evaluations.

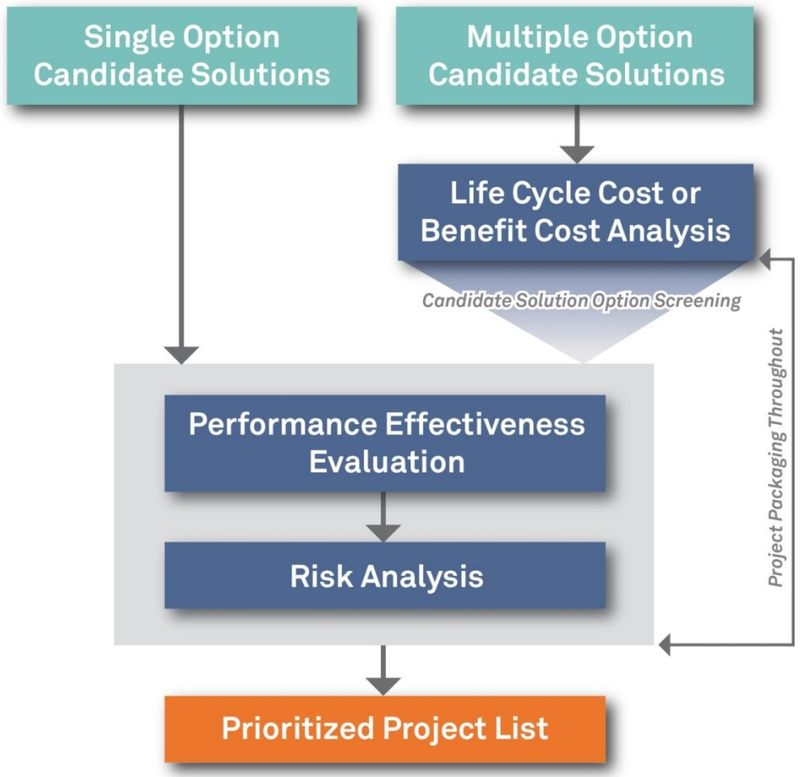
Performance Effectiveness Evaluation – After the LCCA and BCA processes are complete, all remaining candidate solutions will be evaluated based on their performance effectiveness. This process will include determining a performance effectiveness score based on how much each solution increases existing segment level performance scores identified in Working Paper #2 and how much the segment level need in Working Paper #4 is decreased. The results of this evaluation will be combined with the results of the Risk Analysis to determine which solutions have the highest priority in the I-19 corridor.

Risk Analysis – All candidate solutions that are advanced through the Performance Effectiveness evaluation will also be evaluated through a Risk Analysis process. This process will examine the risk of not implementing a recommended solution in terms of overall corridor performance. The results of this analysis will be combined with the Performance Effectiveness scores to determine the highest priority solutions in the I-19 corridor.

The highest ranking solutions will become recommended strategic investments for implementation and compared to recommendations developed through other processes, such as the Programming to Projects Link (P2P) process.

Strategic investments are not intended to be a substitute or replacement for traditional ADOT project development processes where various ADOT technical groups and consultants develop candidate projects for consideration in performance-based programming in the P2P Link process. Rather, these strategic investments are intended to complement ADOT's traditional project development processes with non-traditional projects to address performance needs in one or a combination of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Strategic investments developed for strategic corridors will be considered along with other candidate projects in the ADOT programming process.

Figure 5: Candidate Solution Evaluation Process



APPENDIX A:

Solution Types

PRESERVATION

REHABILITATION

- Rehabilitate Pavement
- Rehabilitate Bridge

MODERNIZATION

GEOMETRIC IMPROVEMENT

- Re-profile Roadway
- Realign Roadway
- Improve Skid Resistance

INFRASTRUCTURE IMPROVEMENT

- Construct Auxiliary Lanes
- Construct Climbing Lane
- Construct Reversible Lane
- Construct Entry/Exit Ramp
- Modify Entry/Exit Ramp
- Replace Pavement
- Replace Bridge
- Implement Automated Bridge De-icing

OPERATIONAL IMPROVEMENT

- Implement Variable Speed Limits
- Implement Ramp Metering
- Implement Lane Control
- Implement Shoulder Running

ROADSIDE DESIGN

- Install Guardrail
- Widen Shoulder
- Rehabilitate Shoulder
- Replace Shoulder
- Install Rumble Strips
- Install Safety Edge

ROADSIDE DESIGN, *cont'd*

- Remove Tree/Vegetation
- Improve Drainage

ROADWAY DELINEATION

- Install High-Visibility Edge Line Striping
- Install High-Visibility Delineators
- Install Raised Pavement Markers

IMPROVED VISIBILITY

- Cut Side Slopes
- Install Lighting

DRIVER INFORMATION/WARNING

- Install Dynamic Message Sign (DMS)
- Install Dynamic Weather Warning Beacons
- Install Speed Feedback Signs
- Install Chevrons
- Install Warning Signs

DATA COLLECTION

- Install Roadside Weather Information System (RWIS)
- Install Closed Circuit Television (CCTV) Camera
- Install Vehicle Detection Stations

EXPANSION

WIDEN CORRIDOR

- Construct New General Purpose Lane

ALTERNATE ROUTE

- Pave Alternate Route
- Construct Frontage Road